

II. BLASTING AND FLYROCK

A. Proposed Findings of Fact Regarding Blasting and Flyrock

76. According to Rivers' blasting expert, Mr. Rath, uncontrolled flyrock occurs when there is face burst, or cratering, or some other accident that happens and rock is thrown considerable distances. (Cross Exam of Rath 12/15/2008)
77. Mr. Rath testified that a face burst can throw flyrock at an initial velocity of 300 feet per second (204.5 mph) or more. (Cross Exam of Rath 12/15/2008)
78. Many blasting accidents involving injury resulting from flyrock occur from excessive flyrock beyond the protected blast zone. (Cross Exam of Rath 12/15/2008)
79. Voids in the ground located between the blast hole and the face can cause serious flyrock situations. (Cross Exam of Rath 12/15/2008)
80. Where blasting operations are conducted in proximity to populated areas flyrock may be a hazard to people, structures, and equipment not on the blasting site. (Cross Exam of Rath 12/15/2008)
81. Even where great care is taken to map and incorporate geology into blast design and implementation, cases may occur where adverse geologic conditions exist in the bank that are unknown. (Cross Exam of Rath 12/15/2008)
82. Rivers' blasting expert cannot guarantee that flyrock will not leave the Rivers parcel, regardless of what precautions are taken to minimize the risk. (Cross Exam of Rath 12/15/2008)
83. Mr. Rath testified that he was concerned for the safety of people living near the proposed quarry site during any blasts, and recommended that anyone within 1,500 feet of a blast remain inside or under cover during the blast. (Cross Exam of Rath 12/15/2008)

84. If a void, mudseam, crack or mis-drilled hole goes unnoticed when a blast is detonated, flyrock could result. (Cross Exam of Rath 12/15/2008)
85. Most flyrock comes off of the face of a blast in what is called a face burst, but flyrock can travel in any direction or multiple directions from a blast. (Cross Exam of Rath 12/15/2008)
86. Bore tracking and laser profiling can identify anomalies in a hole but cannot identify those anomalies between the holes and the face. (Cross Exam of Rath 12/15/2008)
87. An anomaly between holes or between the holes and the face could produce unexpected results, including flyrock. (Cross Exam of Rath 12/15/2008)
88. According to Mr. Rath, the initial velocity of the flyrock in the West Lebanon flyrock accident was over 300 feet per second. (Cross Exam of Rath 12/15/2008)
89. The Applicant's blasting report does not mention flyrock. (Cross Exam of Rath 12/15/2008)
90. The Applicant's plans show Phase 1 being developed with quarry faces directed towards Route 100B. Mr. Rath admitted during cross-examination that he would not recommend blasting the faces as depicted in the site plans, but would instead recommend that Phase 1 be blasted so that that faces start at the farthest point from Route 100B and work back towards the highway. (Cross Exam of Rath 12/15/2008)
91. The Phase 1 blasting progression that Mr. Rath described is not reflected on any site plan or report, nor was it disclosed to anyone prior to Mr. Rath's testimony. The potential effects of this alternate blasting progression on noise, stormwater runoff, or visual impacts has not been considered by the applicant. (Cross Exam of Rath 12/15/2008)

92. Mr. Rath's proposed use of hole liners (which do not appear in any of Rivers' reports, discovery responses or application materials), laser profiling, and bore hole tracking will not eliminate the risk of flyrock. (Cross Exam of Rath 12/15/2008)
93. Even a small crack in the rock connecting to a bore hole can produce flyrock. (Cross Exam of Rath 12/15/2008)
94. The applicant cannot guarantee that flyrock will not reach Route 100B or neighbors' homes. (Cross Exam of Rath 12/15/2008)
95. Art and Linda Hendrickson reside at 495 Old Route 100 in Moretown, Vermont They have made their home there for 35 years. Their house is about 1000 feet from Phase 1 and significantly closer to the Phase 1 construction phase (Line of sight clearing and building of the haul road) (Testimony of Art Hendrickson on 12/15/2008)
96. Art Hendrickson is a high school graduate. He served three years in the U.S. Army as a tracked vehicle mechanic and then worked for General Electric Armaments Division and successor companies for thirty-one years. (Testimony of Art Hendrickson on 12/15/2008)
97. Art Hendrickson's specialty at General Electric was working as an assembler and assembly inspector with prints, plans and parts lists assembling and inspecting complex ammunition handling systems for the military. (Testimony of Art Hendrickson on 12/15/2008)
98. Art Hendrickson is skilled in mathematics and able to understand and apply mathematical formulae, in particular mathematical formulae related to trajectories and throw distances. (Testimony of Art Hendrickson on 12/15/2008)

99. Art Hendrickson acquired his knowledge of blasting and flyrock by doing a substantial amount of online research and purchasing and reading papers from the International Society of Explosives Engineers library, which were the subject of a portion of his testimony. (Testimony of Art Hendrickson on 12/15/2008)
100. Art Hendrickson has read the following ISEE papers:
- Flyrock Control - By Chance or Design (Richards and Moore, 2004), admitted as Rath Cross 1; and Flyrock Prediction and Control in Surface Mine Blasting (Workman and Calder, 2000), admitted as Rath Cross 2. (Testimony of Art Hendrickson on 12/15/2008)
101. Rivers' blasting expert has read Flyrock Control - By Chance or Design (Richards and Moore, 2004), admitted as Rath Cross 1; and Flyrock Prediction and Control in Surface Mine Blasting (Workman and Calder, 2000), admitted as Rath Cross 2. Mr. Rath described these papers, and ISEE publications generally, as excellent, accurate sources that are relied on by professionals in the field of blasting. (Cross Exam of Rath 12/15/2008)
102. Mr. Hendrickson has also read the chapter on explosives (Chap.2) from the National Park Service's Handbook for the Storage, Transportation and Use of Explosives (Nat'l. Park Service, last updated June 27, 2007), which was admitted as Rath Cross 3. (Testimony of Art Hendrickson on 12/15/2008)
103. Mr. Hendrickson has read a large number of other articles and trade journal articles online about blasting and flyrock. (Testimony of Art Hendrickson on 12/15/2008)
104. Mr. Hendrickson has obtained extensive information through Freedom of Information Act (FOIA) requests. More specifically, Mr. Hendrickson has made requests to Mr. Petrie, the Manager of the Northeastern District of MSHA and the Town Administrator of the Town of Morristown. (Testimony of Art Hendrickson on 12/15/2008)

105. Mr. Hendrickson's FOIA requests were made for recent MSHA flyrock accident investigations. (Testimony of Art Hendrickson on 12/15/2008)
106. The MSHA investigations that Mr. Hendrickson reproduced for the Court were identified by Mr. Rath and admitted as RATH CROSS 4, 5 and 6. (Testimony of Art Hendrickson on 12/15/2008)
107. Enclosure Section 2, #4 of N.20 is a response from Mr. Petrie to Chief Keith to Chief Keith's FOIA request.
108. The Morristown Town Administrator provided Mr. Hendrickson, pursuant to Mr. Hendrickson's FOIA request, with a copy of the FOIA response provided to Chief Keith from Mr. Petrie.
109. Mr. Hendrickson decided to study blasting because flyrock is the single most dangerous aspect of Rivers' proposed project. Flyrock launched toward the neighborhood where Art and Linda live would be airborne for approximately ten seconds. That flyrock would hit harder and be traveling faster than when it left the blast and could cause property damage, injury, and even death. (Testimony of Art Hendrickson on 12/15/2008)
110. Every borehole is a separate detonation. This means that during every blast event there would be 62 chances for flyrock from face burst, cratering, or stemming ejection. After every event, there will be an additional ten seconds or so when flyrock could rain down on neighboring homes, properties and Route 100B that could result in property damage, injury, or even death. (Testimony of Art Hendrickson on 12/15/2008)
111. Face burst, cratering, and stemming ejections are all types of blasting occurrences that can lead to flyrock. (Testimony of Tim Rath on 12/15/2008)

112. Flyrock from the proposed quarry would be a significant danger because it is significant enough to require the evacuation of all the nearby homes and the blocking of traffic on Route 100B and Old Route 100. The proposed quarry is located too close to the neighboring homes and to public highways for industrial blasting. (Testimony of Art Hendrickson on 12/15/2008)
113. Flyrock is defined by MSHA as “rock that travels outside of the area that the blaster defines as the blast area.” Rath Cross 6, at 6.
114. A blast area is defined by MSHA as “the area near blasting operations in which concussion or flying material can reasonably be expected to cause injury.” Rath Cross 6, at 6.
115. The nearby homes and Route 100B should be defined as within the blast area for the Rivers’ proposed quarry, because it is reasonable that flyrock will fly that far and cause damage, injury, and possibly even death. (Testimony of Art Hendrickson on 12/15/2008)
116. The Hendrickson home is one of the homes near to Rivers’ proposed quarry.
117. Flyrock is unpredictable. It can happen whenever a blast occurs. While the occurrence of flyrock is unpredictable, it is possible, given a set of assumptions, to estimate how far the flyrock will travel. (Testimony of Art Hendrickson on 12/15/2008 & Cross exam testimony 12/15/2008)
118. Mr. Hendrickson prepared exhibits E.5 of N.20 and §2, #9 of N.20 in which he estimated the distance flyrock would travel if it occurred. The exhibits are based on the formulas set out in Rath Cross 1 and Rath Cross 2 and are illustrations of those formulas as applied to the physical characteristics on the proposed quarry site.

119. Mr. Hendrickson, after explaining his illustration, Flyrock Prediction/ANFO .85 cc., N20, Section 2, 9, demonstrated how anomalies in the burden actually become the face and the effect on they have on flyrock throw. He gave a short demonstration with a measuring tape. He explained that the quarry wall and blast hole would be four stories high with a burden of eight feet in front of the blast holes. He extended his tape out 96 inches (8 feet) and stated at that distance the flyrock would go 32 feet. He shortened the tape 47 inches and stated with that much burden the flyrock would go 311 feet. He shortened the tape 20 inches more and stated that with that much burden the flyrock would go 1,451 feet. He shortened the tape six inches more and stated that now the flyrock would go over 3000 feet. He then said, "That is how dangerous a detonation can be." (Testimony of Art Hendrickson on 12/15/2008)
120. Mr. Hendrickson knew of five recent Vermont flyrock incidents. Four incidents involved homes and/or buildings being hit by flyrock and one in which a person was injured from flyrock. They are; the one in the investigator's notes of the Percy Quarry in Morristown (in that one, at the Manosh Pit, a house got peppered), the Morristown Percy quarry twice 4-22-08 and 9-9-08 and at the Ireland Quarry in So. Burlington on 9-24-08. The flyrock incident involving injury was at the Percy Quarry and involved someone in the mobile home park in 2007. (Testimony of Art Hendrickson on 12/15-16/2008 & N-20 Section 2 #2.4)
121. Mr. Hendrickson commented there was additional information in the Percy quarry investigator field notes such as the quote "after a blast the water in the trailer park turns brown," and notations of damage to homes and broken windshields. Mr. Hendrickson testified that "there are so many things in the investigator's notes that you get an

- understanding what it is like to live there. I do not want to live like that.” (Testimony of Art Hendrickson on 12/15/2008 & N-20 Section 2 #2.4)
122. Even if everything goes as planned, and even if it were level ground, the Hendrickson house is within the recommended personnel exclusion zone. (Testimony of Art Hendrickson on 12/15/2008).
 123. The MSHA investigation of a flyrock accident at the Percy Quarry on Cochran Road in Morristown, Vermont, admitted as § 2, #4 of N.20, provides details about flyrock that hit people’s homes.
 124. The Percy Quarry flyrock accident occurred on April 22, 2008. During the incident, flyrock consisting of rocks four to eleven inches long flew off of the quarry site and struck neighboring houses and the Morristown Highway Garage. Smaller pieces of flyrock impacted the neighboring homes with so much force the flyrock was found embedded in a metal post and a lawn landscaping rock, as shown in the investigator’s photographs included in § 2, #4 of N.20.
 125. The Percy quarry is similar to the proposed Rivers quarry in many ways. The distance to the nearby homes, blasthole diameters, blasthole depths, blasting agents, and geology are all similar to Rivers’ blasting plan. (Testimony of Art Hendrickson on 12/15/2008 & N-20 Section 2 #2.4)
 126. Mr. Hendrickson obtained information about the Percy quarry by closely reviewing the MSHA flyrock investigation report that contained this information, and comparing it to the Rivers’ blasting plan. (Testimony of Art Hendrickson on 12/15/2008 & N-20 Section 2 #2.4)

127. The topography in Moretown makes the Rivers' proposed quarry much more dangerous than the Percy quarry. The Percy quarry is on approximately the same level as the mobile home park that was hit by flyrock. The Rivers' proposed quarry would be hundreds of feet above homes on the top of a hill. Flyrock thrown from the top of a hill will travel farther and impact harder than on level ground or from below grade. (Testimony of Art Hendrickson on 12/15/2008)
128. The Percy quarry was developed before the nearby mobile home park. The homes and horse farms near the Rivers proposed quarry, by contrast, predate Rivers' application by decades. The McMullin horse farm, for instance, has been operated by the McMullins for thirty-one years, and was operated by its previous owners for at least twenty years prior to that.
129. In the Percy Quarry flyrock accident, flyrock flew 718 feet into the mobile home park. (Testimony of Art Hendrickson on 12/15/2008 & N-20 Section 2 #2.4)
130. The flyrock was launched at approximately 152 feet per second to travel 718 feet over level terrain. (Testimony of Art Hendrickson on 12/15/2008)
131. Because of the higher elevation of the proposed Rivers quarry in relation to the Mad River Valley, flyrock thrown from the quarry toward the River at an initial velocity of 152 feet per second would travel 870 feet from the Rivers' blast site. (Testimony of Art Hendrickson on 12/15/2008)
132. It is 720 feet from the proposed quarry to the Holden residence. (Gunner McCain testimony and site plans)

133. Flyrock from blasting at the Percy quarry was also thrown onto the grounds of the Morristown town garage. Some flyrock landed on the roof of the building. (Testimony of Art Hendrickson on 12/15/2008 & N-20 Section 2 #2.4)
134. The Morristown town garage is located about 686 feet from where the blast site was, and in a different direction than the mobile home park. (Testimony of Art Hendrickson on 12/15/2008 & N-20 Section 2 #2.4)
135. Two citations were issued to the blaster because of the flyrock incident at the Percy quarry. One of the citations was modified by James Petrie, Manager of the Northeast District of Metal and Nonmetal Mine Safety and Health Administration, for failing to warn or evacuate people in the nearby mobile home park. These citations are included in the MSHA accident report admitted as §2, #4 of N.20.
136. In §2, #4 of N.20, under subsection 10, titled "Gravity," the report states that the accident was likely to produce injury, that such injury was reasonably expected to be fatal, and the risk was significant and substantial.
137. There was another flyrock incident at the Percy quarry since this incident in which flyrock was again thrown into the Pine Crest mobile home park on September 9, 2008 (Testimony of Art Hendrickson on 12/16/2008)
138. There have been two recent significant flyrock incidents in the last year and a half in West Lebanon, NH and South Burlington, VT. (Testimony of Art Hendrickson on 12/15/2008)
139. In the West Lebanon, NH incident, flyrock was thrown up to four thousand feet in two different directions and landed at Technica USA and the West Lebanon Airport, as described in the report admitted as Rath Cross 4 (prepared by Green Mountain

Explosives, Mr. Rath's company) and in the MSHA investigation report admitted as Rath Cross 5.

140. The internal investigator's report of the West Lebanon, NH incident (Rath Cross 4) describes the damage as minor, with little flyrock, and failed to mention that flyrock flew to the airport. But the MSHA investigation report of the incident (Rath Cross 5) shows pictures of the extensive damage that was caused by the flyrock; one picture shows a piece of flyrock as big as a bucket. The internal investigator's report also failed to mention that the flyrock damaged eleven cars and landed near the airport's runway #36, spreading dirt and debris onto the runway.
141. The parking lot and broken window were approximately 3000 feet from the blast site, and the airport was approximately 4000 feet from the blast site. (Rath Cross 5)
142. Mr. Rath did the internal investigation for Green Mountain Explosives. (Rath Cross 4)
143. Mr. Hendrickson visited Technica USA in the industrial park and viewed three pieces of flyrock from the West Lebanon, NH incident that were the size of a golf ball, baseball and softball. (Testimony of Art Hendrickson on 12/15/2008)
144. In September of 2008, flyrock from a quarry blast in South Burlington was thrown several hundred yards and did over a million dollars in damage to vehicles, buildings, and airplanes. (Testimony of Art Hendrickson on 12/15/2008)
145. Flyrock poses a serious and significant threat to nearby homes, property, and people. Flyrock from the Rivers' proposed quarry will create a significant danger to homes that are within the range of the flyrock, and the public that uses Route 100B. Flyrock can travel long distances and cannot always be controlled, even by experienced blasters. The

Rivers' proposed quarry is too close to residences and public highways. (Testimony of Art Hendrickson on 12/15/2008)

B. Proposed Conclusions of Law Regarding Blasting and Flyrock

Blasting at the proposed quarry would have several materially adverse impacts upon the surrounding properties and uses, including substantial risks to the Neighbors' water supply from toxic chemical spills and altered groundwater flow patterns, air quality impacts from dust, and aesthetic impacts including noise over 70 dBA beyond the Rivers' property line. These risks and impacts are addressed more fully in other sections of this decision; here we focus only on the hazard that flyrock poses to neighboring properties and uses.

Flyrock is rock propelled by an explosion outside of the defined blast area. Flyrock occurs for a number of reasons, including face bursts, stemming ejections, and cratering, which in turn are often the result of undetected voids, mud seams, or other anomalies in the rock. Even a very small crack in the rock connecting to a bore hole can produce flyrock. Flyrock can travel at great velocities over great distances. For example, the flyrock accident described by Rivers' blasting expert in West Lebanon, New Hampshire, caused a head-sized fragment of rock to travel off of the quarry site at over 300 feet-per-second (204.5 mph) and land some 4000 feet away, with other fragments breaking a window and a stone curb at the Technica USA parking lot, some 3000 feet away from the blast. Mr. Hendrickson testified to five other recent examples of flyrock accidents resulting from quarry blasting in Vermont, some of which resulted in pieces of flyrock striking with enough force to become embedded in a metal post and a landscaping rock more than 700 feet away from the blast.

Flyrock is unpredictable and dangerous. Flyrock can travel in any direction or multiple directions from a blast. Rivers' blasting expert cannot guarantee that flyrock will not leave the

Rivers parcel, no matter what precautionary measures are taken. Out of concern for the Neighbors' safety, Rivers' blasting expert recommends that anyone within 1,500 feet of a blast remain inside or under cover. It is unclear whether remaining inside would protect against a head-sized rock fragment traveling over two hundred miles per hour. Numerous Neighbors, including Parties Holden, Porter, Hendrickson, Byrne/Farley, McMullin and Sanders, are within this 1,500 danger zone, as shown on the uncontroverted map admitted as Neighbors' Exhibit N.14. The Holden residence, for example, is a mere 720 feet from the proposed quarry site.

The risk of flyrock is substantial and material, and cannot be eliminated from the proposed project. The risk of flyrock would be present every time there is a blast, i.e., ten or more times a year for 33 years. Errant flyrock could result in injury to or the death of nearby residents, injury to or death of the horses at the Mad River Stables on the McMullin property, and damage to homes and property.

Because the risk of flyrock leaving the Rivers parcel cannot be eliminated by Rivers, the risk of property damage, injury, or death will be borne by the Neighbors to the proposed quarry. We cannot condone that shifting of risk onto the long-time residents and farms that have existed in this portion of the Mad River Valley for many years prior to Rivers' pending applications.

Neighbors' Question #12 of their Statement of Questions in Docket No. 7-1-05 Vtec asks: "Whether, under MZR Section 3.5(C), the application and proposed quarry will not cause a hazard to public health or safety?" We must conclude that because Rivers cannot eliminate the risk of high-velocity rock fragments leaving its property whenever a blast is conducted, the proposed quarry will cause a hazard to the health and safety of nearby residents, recreational users of the area, and travelers on Route 100B, in violation of MZR § 3.5(C).

Neighbors' Question #12 of their Statement of Questions in Docket No. 7-1-05 Vtec asks: "Whether, under MZR Section 4.10(A), the land or structure(s) for the application and proposed quarry will be used or occupied in any manner so as to create dangerous, injurious or noxious conditions that adversely affect the reasonable use of adjoining or nearby properties?" We must conclude that Rivers proposes to use its land so as to create a dangerous condition that adversely affects the reasonable use of adjoining and nearby properties, in violation of MZR§ 4.10(A).⁷

Neighbors' Question #13 of their Statement of Questions in Docket No. 7-1-05 Vtec asks, in part: "Whether, under MZR Section 4.10(B)(1)-(5), the application and proposed quarry meets the following standards: [. . .] (3) No fire, explosive or safety hazard shall be permitted which significantly endangers other property owners or which results in a significantly increased burden on municipal facilities." We must conclude that Rivers' proposed quarry creates an explosive and safety hazard which significantly endangers other property owners, in violation of MZR § 4.10(B)(3).

Neighbors' Question #14 of their Statement of Questions in Docket No. 7-1-05 Vtec asks, in part: "Whether, under MZR Section 5.2(C), the application and proposed quarry will not adversely affect [the conditional use criteria, including the character of the area and the bylaws in effect]?" We must conclude that Rivers' proposed quarry would have a substantial and material adverse effect on the character of the area by introducing a dangerous industrial use into this bucolic neighborhood characterized by single family homes, horse farms, and quiet recreational pursuits. In addition, the proposed quarry would adversely affect the bylaws in effect, including MZR §§ 4.10(A) and 4.10(B)(3).

⁷ MZR§ 4.10(A) reads in its entirety: "No land or structure in any zoning district shall be used or occupied in any manner so as to create dangerous, injurious or noxious conditions that adversely affect the reasonable use of adjoining or nearby properties."

Neighbors' Question #8 of their Clarified Statement of Questions in Docket No. 68-3-07 Vtec asks: "Does the proposed quarry fail to comply with 10 V.S.A. § 6086(a)(8) because it will have an undue adverse effect on aesthetics, including the scenic or natural beauty of the area, due to noise, trucks, blasting, crushing, drilling, dust, and an industrial scar on the landscape, a scenic landscape that currently supports residential and recreational uses and several horse farms?" We must conclude that the blasting activity on Rivers' proposed quarry would have an undue adverse effect on aesthetics under Criterion 8, even without considering the other proposed quarry activities.

Neighbors' Question #9 of their Clarified Statement of Questions in Docket No. 68-3-07 Vtec asks: "Does the proposed quarry fail to comply with 10 V.S.A. § 6086(a)(9)(E) because Rivers has failed to prove that the proposed quarry will not have an unduly harmful impact upon the surrounding environment or surrounding uses and development, and/or because Rivers will not leave the site in a condition suited for alternative use or development?" We must conclude that Rivers has failed to prove that its proposed blasting will not have an unduly harmful impact upon surrounding uses and development under Criterion 9(E).

In accordance with the forgoing, the Court must rule in favor of the Neighbors on Neighbors' Questions 12, 13, and 14 in Docket No. 7-1-05 Vtec and Neighbors Questions 8 and 9 in Docket No. 68-3-07 Vtec.